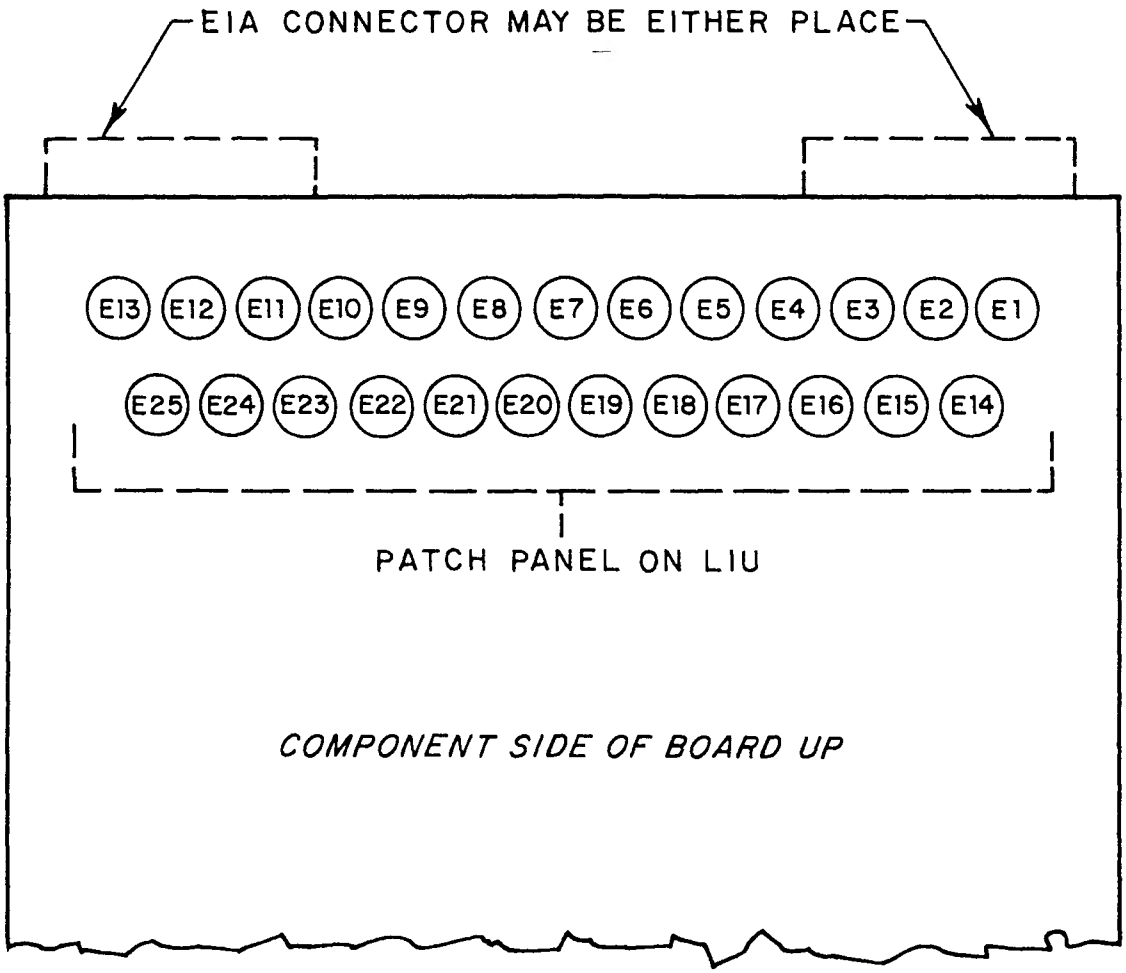

EIA CONNECTOR MAY BE EITHER PLACE
E13 E12 E11 E10 E9 E8 E7 E6 E5 E4 E3 E2 E1
E25 E24 E23 E22 E21 E20 E19 E18 E17 E16 E15 E14
PATCH PANEL ON LIU
COMPONENT SIDE OF BOARD UP

FIG. A-1 LIU PIN DIAGRAM

TABLE A-1

STANDARD LIU PATCH PANEL CONFIGURATIONS

LIU pin for connection to:

| EIA PIN | TERMINAL | 103 |
|---|---|---|
| 1 | E1 | E1 |
| 2 | E3 | E2 |
| 3 | E2 | E3 |
| 4 | E5 | E4 |
| 5 | E4 | E5 |
| 6 | E19 | E6 |
| 7 | E7 | E7 |
| 8 | E20 | E8 |
| 9 | -- | -- |
| 10 | -- | -- |
| 11* | E11 | E11 |
| 12 | E12 | E12 |
| 13 | E13 | E13 |
| 14 | E16 | E14 |
| 15 | E17 | E15 |
| 16 | E14 | E16 |
| 17 | E15 | E17 |
| 18 | -- | -- |
| 19 | E6 | E19 |
| 20 | E8 | E20 |
| 21 | -- | -- |
| 22 | -- | -- |
| 23 | -- | -- |
| 24 | E25 | E24 |
| 25 | E24 | E25 |

When a card is wired for a particular configuration, it is customary to specify that configuration (e.g. "M103" or "T") on the plastic block on the LIU card.

*Not all LIU cards have this wire. It is not necessary for operating 103 modems, or any terminals we know of.

# APPENDIX B

## TERMINALS WHICH HAVE BEEN CONNECTED TO A TIP

# HAZELTINE 2000

## Description:

The Hazeltine 2000 is a video display terminal capable of data rates from 110 to 9600 baud, full- or half-duplex. Its screen can hold up to 27 lines of up to 74 characters each. Hard copy and tape cassettes are available options. This terminal is designed to operate over 103- or 202-type modems, or to be connected directly.

## Connection to the TIP:

This terminal comes with an EIA RS-232B interface which may be connected directly to a "T" LIU card (see Appendix A). The DATA TERMINAL READY lead is controlled by the POWER switch, and is not affected by any keyboard buttons.

The parity switch should be set to 1; the others may be set as desired.

## Operation:

When the terminal comes on, make sure the rate is set to 110, 150, or 300, and type E. In this case, SHIFT and E cause the character U to be produced, so just type E. When HELLO is received, it is possible to set up other device rates as described in the TIP User's Guide, then the terminal can be changed to the other speed.

## HAZELTINE 2000 (Page Two)

The Hazeltine 2000 does not respond well to cycling power ON and OFF*; therefore, try to get HELLO before typing many other characters.

*According to the Hazeltine Service Representative, there is a design flaw in the power supply, such that about one time in ten power does not come up properly. If this happens, turn power off, wait 15 seconds and try again.

# IBM 2741

Model: (presently - inquire for others)

2741 Correspondence models*

| | | | |
|---|---|---|---|
| 001 | 007 | 010 | 012 |
| 015 | 019 | 029 | 043 |

2741 PTTC models*

| | | | |
|---|---|---|---|
| 938 | 939 | 942 | 943 |
| 947 | 948 | 961 | 962 |
| 963 | 996 | 997 | 998 |

For operation with the TIP, it is necessary to have the 2741 equipped with the following options:

| | IBM Sales Number |
|---|---|
| Transmit Interrupt | 7900 |
| Interrupt | 4708 |
| Data Set | 9114 |
| Dial-up | 3255 |

If any difficulty occurs in ordering these options, contact BBN.

Description:

The IBM 2741 is a hard-copy terminal which operates at 134.5 baud, half-duplex. Its keyboard and printer are very similar to a Selectric typewriter.

Connection to the TIP:

With the 2741 equipped as required, it is only necessary to plug its EIA compatible plug into an LIU which has been configured for terminals (see Appendix A).

---

*The model number is hidden on the typeball.

## IBM 2741 (Page Two)

Operation:

Turning power ON connects the terminal and starts "hunt" mode. See the TIP User's Guide, Section IV, for the appropriate character for describing this terminal to the TIP.

See the TIP User's Guide, Section VI, for a description of the code conversion for sending the full ASCII character set from a 2741.

# INFOTON VISTA

Version: VISTA 1H

Description:

The Infoton Vista is a video display terminal capable of data rates from 110 to 4800 baud, full- or half-duplex. Its screen can hold up to 20 lines of 80 characters each. It is presently able to operate over 103 modems, and perhaps will operate over 202 modems in the future. Its standard interface allows EIA or Teletype compatible current loop connection.

Connection to the TIP:

This terminal comes with the Multipurpose Asynchronous Serial Interface which provides an EIA connector which may be connected directly to a "T" LIU card (see Appendix A).

The controls can be set as desired.

Operation:

When the terminal comes ON, make sure the rate is set to 110, 150, or 300 and type E. When HELLO is received, it is possible to set up other device rates as described in the TIP User's Guide. The terminal can then be switched to that rate.

Turning power off disconnects the terminal.

# TELETYPE MODEL 37

Version: KSR

For proper connection to the TIP, the "OUT OF SERVICE" feature must be available:

Description:

The 37 KSR TTY set is a heavy duty hard copy terminal capable of operating at 100 or 150 words per minute (110 or 150 baud). It is capable of printing upper and lower case, and may be used over a 103 modem. It has many variable user features.

Connection to the TIP:

To connect a 37 TTY to the TIP, it is necessary to strap the following options. These jumpers are found on card #322068 which is in slot XZ109 of the Teletype.

| Jumper | Result |
|---|---|
| A-OUT<br>B-OUT | These keep EOT's and Alarms from disconnecting the terminal. |
| C-IN<br>D-OUT | Makes motor power follow DATA SET READY lead. |
| E-OUT<br>F-OUT<br>G-OUT<br>L-OUT | Configures OUT OF SERVICE switch to act as ON/OFF switch for DATA TERMINAL READY. |
| H-IN<br>Y-IN | Keeps terminal in PROCEED Mode when ON-LINE. |
| K-OUT | Prevents sending a BREAK on Parity Error. |
| M-OUT | Enables sending BREAK manually. |

## TELETYPE MODEL 37 (Page Two)

In order to have the OUT OF SERVICE switch control the motor power, it is necessary to connect DATA SET READY to DATA TERMINAL READY on the LIU card. Table TTY 37-1 shows the connection which produces this configuration.

Operation:

When the teletype is connected in this way, the OUT OF SERVICE button has the effect of a POWER switch for the motor circuitry. The logic is, however, always ON. Therefore, when the OUT OF SERVICE light is ON, the TTY is OFF. Pushing the OUT OF SERVICE button will turn the motor on, and initiate "hunt" mode in the TIP (if enabled). Pushing that button again disconnects the Teletype, and turns off the motor.

Special Characters:

CONTROL D (EOT) - This reinitializes the Teletype, but does not disconnect it from the TIP.
CONTROL N (SO) - This disables printing.
CONTROL O (SI) - This enables printing.

Comments:

In this configuration, this terminal can still be used over 103 modems.

Full-half duplex options may be selected by straps on card #322062 which is in location XZ107.

## TELETYPE MODEL 37 (Page Three)

| | |
|---|---|
| Dedicated HALF-DUPLEX: | A-IN, B-OUT, C-OUT |
| Dedicated FULL-DUPLEX: | A-OUT, B-IN, C-OUT |
| LINE CONTROL OPERATION: | A-OUT, B-OUT, C-OUT |

In addition, the "STUNT" box must be correctly wired--this is a Teletype Corp. operation.

## TELETYPE MODEL 37 (Page Four)

### TABLE ITY 37-1

### LIU Pad Configuration for Model 37 TTY

| EIA PIN | LIU PAD | |
|---|---|---|
| 1 | E1 | |
| 2 | E3 | |
| 3 | E2 | |
| 4 | E5 | |
| 5 | E4 | |
| 6 | E8 | - Both EIA pin 6 and pin 20 connect to E8. This is the only change to a "T" LIU card. |
| 7 | E7 | |
| 8 | E20 | |
| 9 | -- | |
| 10 | -- | |
| 11 | E11 | |
| 12 | E12 | |
| 13 | E13 | |
| 14 | E16 | |
| 15 | E17 | |
| 16 | E14 | |
| 17 | E15 | |
| 18 | -- | |
| 19 | E6 | |
| 20 | E8 | - See EIA pin 6. |
| 21 | -- | |
| 22 | -- | |
| 23 | -- | |
| 24 | E25 | |
| 25 | E24 | |

## ASCII CODES (Octal)

| MSD→ / LSD↓ | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 30 | 31 | 32 | 33 | 34 | 35 | 36 | 37 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | "@" NUL | "H" BS | "P" DLE | "X" CAN | SPA-CE | ( | _0 | 8 | @ | H | P | X | ` | h | p | x |
| 1 | "A" SOH | "I" HT | "Q" DC1 | "Y" EM | ! | ) | 1 | 9 | A | I | Q | Y | a | i | q | y |
| 2 | "B" STX | "J" LF | "R" DC2 | "Z" SUB | " | * | 2 | : | B | J | R | Z | b | j | r | z |
| 3 | "C" ETX | "K" VT | "S" DC3 | "[" ESC | # | + | 3 | ; | C | K | S | [ | c | k | s | { |
| 4 | "D" EOT | "L" FF | "T" DC4 | "\" FS | $ | , | 4 | < | D | L | T | \ | d | l | t | \| |
| 5 | "E" ENQ | "M" CR | "U" NAK | "]" GS | % | - | 5 | = | E | M | U | ] | e | m | u | } |
| 6 | "F" ACK | "N" SO | "V" SYN | "↑" RS | & | . | 6 | > | F | N | V | ↑ | f | n | v | ~ |
| 7 | "G" BEL | "O" SI | "W" ETB | "←" US | ' | / | 7 | ? | G | O | W | ← | g | o | w | RUB OUT |

"X" means Control and X

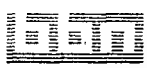
| Code | Rate (baud) |
|---|---|
| 0 | illegal |
| 1 | 75 |
| 2 | 110 |
| 3 | 134.5 |
| 4 | 150 |
| 5 | 300 |
| 6 | 600 |
| 7 | 1200 |
| 10 | 1800 |
| 11 | 2400 |
| | ---- |
| 12 | 4800 (output only) |
| 13 | 9600 (output only) |
| 14 | 19200 (output only) |
| 15 | illegal |
| 16 | illegal |
| 17 | external clock |

REPORT NO. 2277

# TERMINAL INTERFACE MESSAGE PROCESSOR

## Specifications for the Interconnection of Terminals and the Terminal IMP

Developed for
the Advanced Research Projects Agency
by Bolt Beranek and Newman Inc.



# EIA RS 232 INTERFACE CONNECTION PIN ASSIGNMENTS

| Pin Number | Circuit | Description |
|---|---|---|
| 1 | AA | Protective Ground |
| 2 | BA | Transmitted Data |
| 3 | BB | Received Data |
| 4 | CA | Request to Send |
| 5 | CB | Clear to Send |
| 6 | CC | Data Set Ready |
| 7 | AB | Signal Ground (Common Return) |
| 8 | CF | Received Line Signal Detector |
| 9 | — | (Reserved for Data Set Testing) |
| 10 | — | (Reserved for Data Set Testing) |
| 11 | | Unassigned |
| 12 | SCF | Sec. Rec'd. Line Sig. Detector |
| 13 | SCB | Sec. Clear to Send |
| 14 | SBA | Secondary Transmitted Data |
| 15 | DB | Transmission Signal Element Timing (DCE Source) |
| 16 | SBB | Secondary Received Data |
| 17 | DD | Receiver Signal Element Timing (DCE Source) |
| 18 | | Unassigned |
| 19 | SCA | Secondary Request to Send |
| 20 | CD | Data Terminal Ready |
| 21 | CG | Signal Quality Detector |
| 22 | CE | Ring Indicator |
| 23 | CH/CI | Data Signal Rate Selector (DTE/DCE Source) |
| 24 | DA | Transmit Signal Element Timing (DTE Source) |
| 25 | | Unassigned |

Report No. 2277

Bolt Beranek and Newman Inc.

NIC No. 11625

# SPECIFICATIONS FOR THE INTERCONNECTION OF TERMINALS AND THE TERMINAL IMP

R.D. Rettberg

Sponsored by:

Advanced Research Projects Agency
ARPA Order No. 1260
Contract No. DAHC15-69-C-0179

6/73

Line Interface Units may only be removed by BBN or Honeywell personnel. If you believe that a change to the patch panel of the LIU is needed, contact BBN.

TABLE OF CONTENTS

PAGE

1. INTRODUCTION . . . . . 1

1.1 Terminals Which Can Be Connected to the TIP . . . . 1
1.2 Connection of Terminals to the TIP . . . . . 1
1.3 The User's Point of View on Terminal Connection . . 3

2. DESCRIPTION OF TIP HARDWARE AND SOFTWARE . . . . . 5

2.1 General Hardware Considerations . . . . . 5
2.2 Data Flow in the MLC . . . . . 9
2.2.1 Input . . . . . .14
2.2.2 Output . . . . . .14
2.3 Software Description . . . . . .18

3. TERMINAL/TIP INTERFACE SPECIFICATION . . . . . .19

4. MODEMS . . . . . .25

4.1 Half-Duplex Modems . . . . . .25
4.2 Synchronous Modems . . . . . .26
4.3 103 Modems . . . . . .26

APPENDIX A: STANDARD LIU CARD CONFIGURATION . . . . . .29

APPENDIX B: TERMINALS WHICH HAVE BEEN CONNECTED TO A TIP .35

EIA RS 232 INTERFACE CONNECTION PIN ASSIGNMENTS . inside front cover

ASCII CODES (Octal) . . . . . inside back cover

# 1. INTRODUCTION

The ARPA Network provides the capability for geographically separated computers called Hosts to communicate with each other and with a wide variety of terminal devices. Each Host computer is connected to the ARPA Network through a small computer which is called an Interface Message Processor (IMP). Terminals are connected to the ARPA Network through a Terminal IMP (TIP) which consists of an IMP and a Multi-Line Controller (MLC). A typical node on the ARPA Network is shown in Figure 1-1.

This document contains the information for connecting terminals and modems to the TIP.

## 1.1 Terminals Which Can Be Connected to the TIP

Appendix B provides a description of the terminals which have been successfully connected to the TIP. If it is desired to connect a terminal which is not described in Appendix B, consult Section 3 for the terminal specification. Terminals which violate the software specification (Table 3-1) may also be connected by appropriate software modifications. Be certain to contact BBN early if software modifications are necessary.

## 1.2 Connection of Terminals to the TIP

The sections listed below describe the details of Terminal Interfacing. In many cases, this detail will not be necessary for connecting your terminal to the TIP.

- If your terminal is described in Appendix B, follow the relevant suggestions.

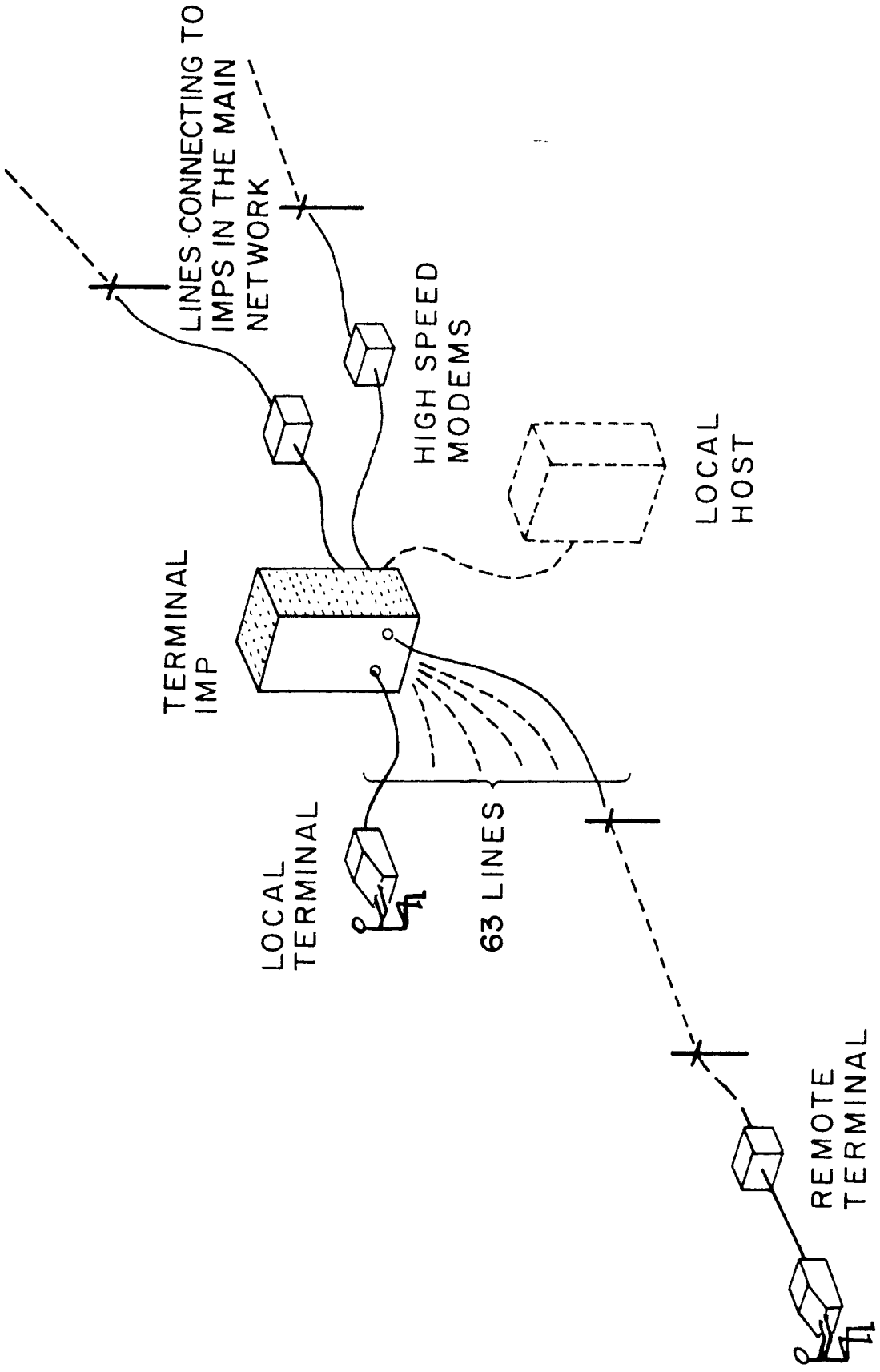



FIG. 1-1 A TIP IN THE NETWORK

- If your terminal has a 25-pin plug, try plugging it into an LIU (located at the bottom of the TIP) which has a "T" label. If this works, set the terminals rate to 110, 150, or 300 baud, and type E. HELLO means that you are connected. Refer to the *User's Guide to the Terminal IMP*, BBN Report No. 2183.

If these methods fail, you should consult the following sections of this manual:

Section 2 gives a brief description of the configuration of a TIP. The subsection on data flow in the MLC (2.2) may help you determine the problem by means of the display console indicators.

Section 3 gives specifications for terminal connection. Through studying this you may be able to determine what is wrong.

Section 4 discusses modems.

If you succeed in connecting a terminal which is not listed, please let us know in some detail how it was done, and how well it works. Please contact:

Network Control Center
Bolt Beranek and Newman Inc.
50 Moulton Street
Cambridge, Massachusetts 02138

The same address may be used for obtaining further information.

## 1.3 The User's Point of View on Terminal Connection

It is strongly suggested that anyone intending to connect terminals to the TIP, as well as anyone wishing to know how the TIP is used, read the *User's Guide to the Terminal IMP*, BBN Report No. 2183.

The topics of particular interest in connecting terminals are:

- The Network Virtual Terminal
- Typical Uses of the TIP
  - Echoing
  - Break
- "Unusual" Uses of the TIP
  - Device Parameters
  - Setting Another Terminal's Parameters
  - The DIVERT OUTPUT Command

Line Interface Units may only be removed by BBN or Honeywell personnel. If you believe that a change to the patch panel of the LIU is needed, contact BBN.

# 2. DESCRIPTION OF TIP HARDWARE AND SOFTWARE

A functional diagram of the BBN TIP hardware is shown in Figure 2-1. The TIP consists of two major assemblies: the basic H316 IMP, and the Multi-Line Controller (MLC). The IMP section performs the message handling functions of a node in the network, and provides additional processing power for the MLC. Information on the basic IMP section may be found in BBN Report No. 1877. The MLC section is described in detail in BBN Report No. 2184.

The MLC consists of Common Logic, and Line Interface Units (LIU). Each LIU services an input and an output on the TIP. Terminals and modems are connected to these ports. Up to 63 LIU's may be installed in the TIP. As one option, a rack of up to 16 modems may be mounted inside the TIP enclosure.

A photograph of a TIP is shown in Figure 2-2 which indicates the location of these assemblies. The option drawer above the main processor contains additional network (as opposed to terminal) modem interfaces and Host interfaces. The H316 main frame drawer houses the basic processor. The MLC drawer is immediately below the processor, and holds the MLC common logic. On the front of this drawer is the MLC console. At the bottom of the TIP is the LIU rack, which holds the LIU cards.

Throughout the remainder of this section, we will not make any effort to distinguish between the contributions of the LIU and the Common Logic to a port's function.

## 2.1 General Hardware Considerations

*Data Format* - The MLC hardware data format is bit serial with characters framed by start and stop bits:

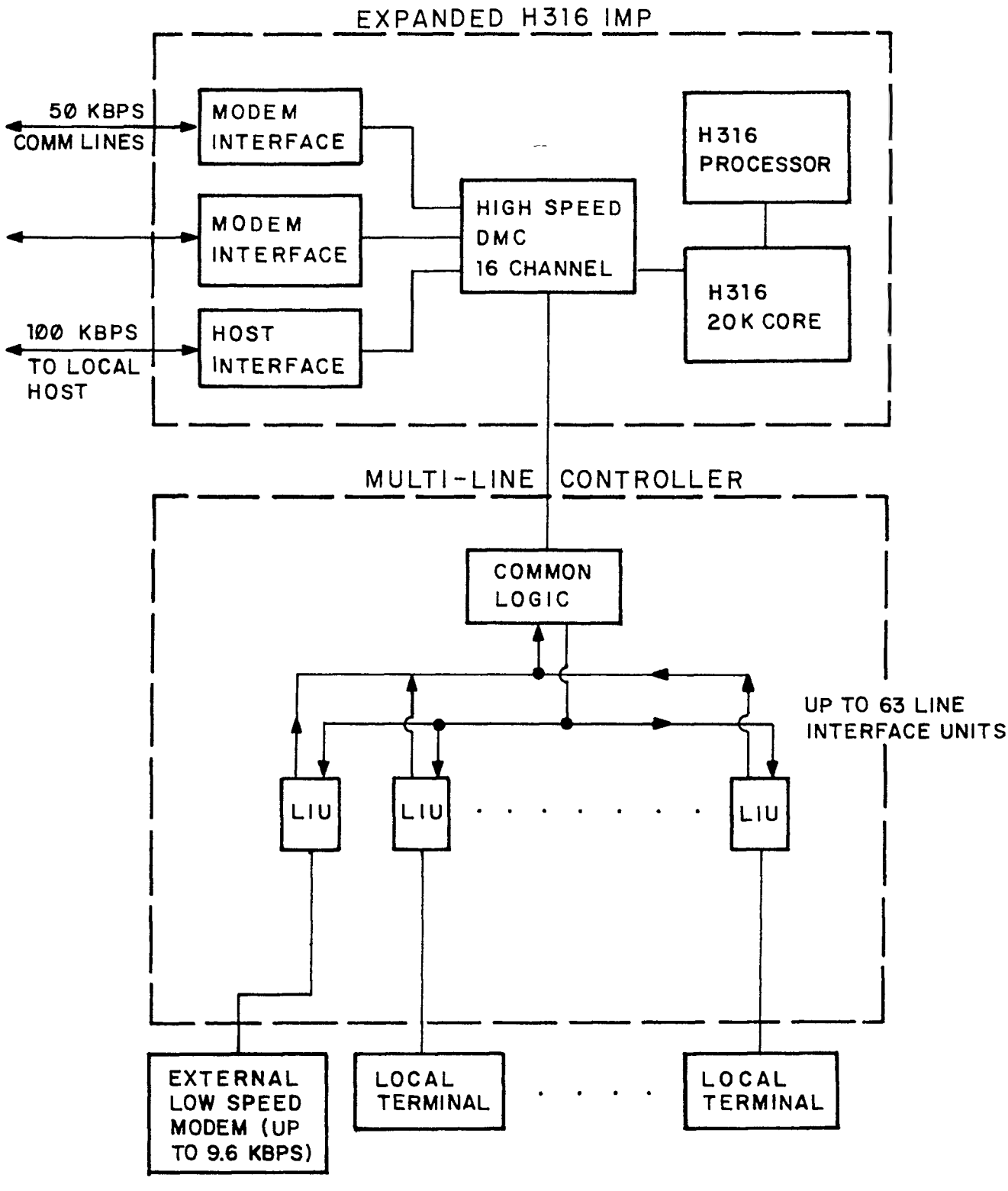



FIG. 2-1 BBN TIP HARDWARE CONFIGURATION

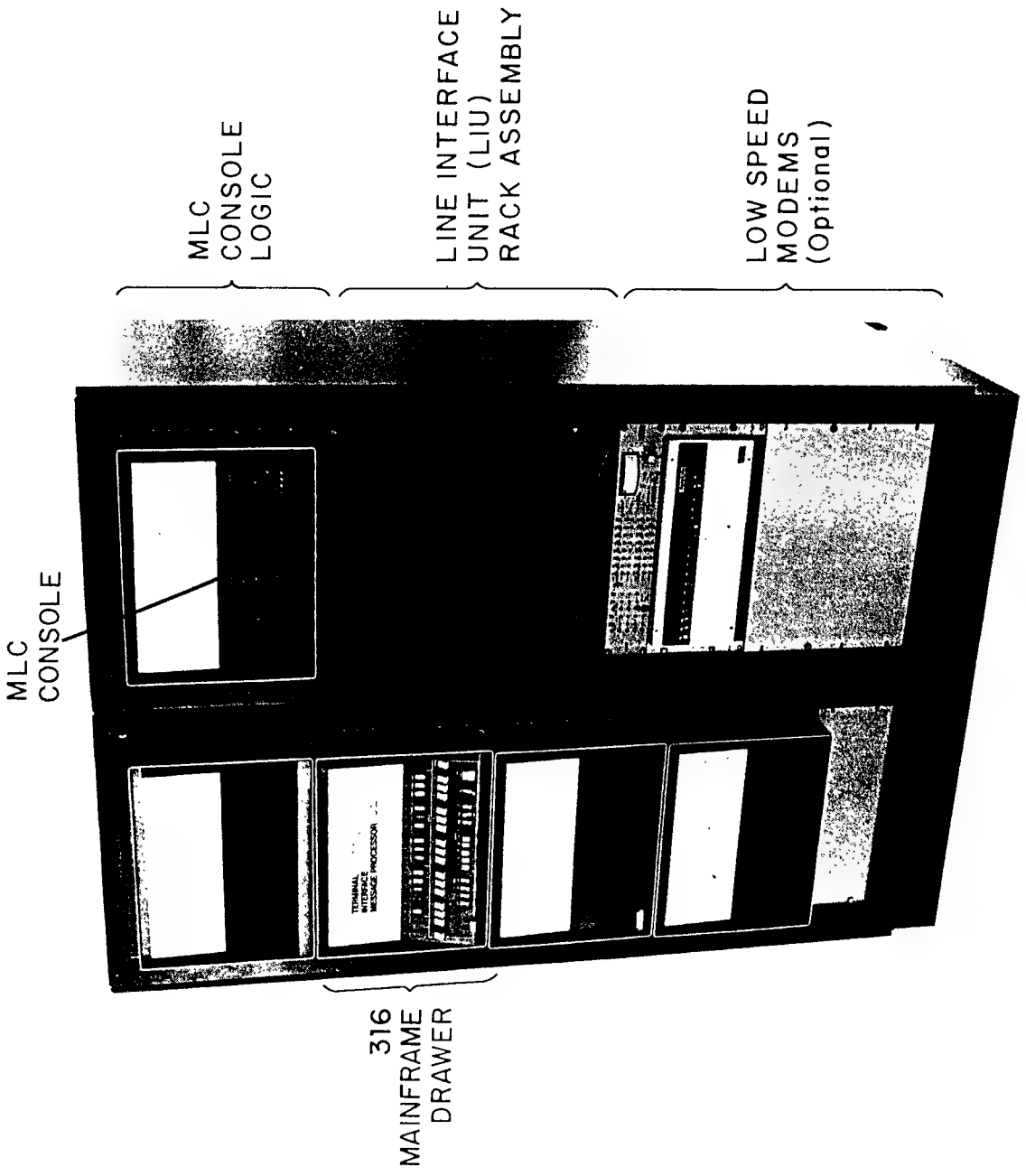
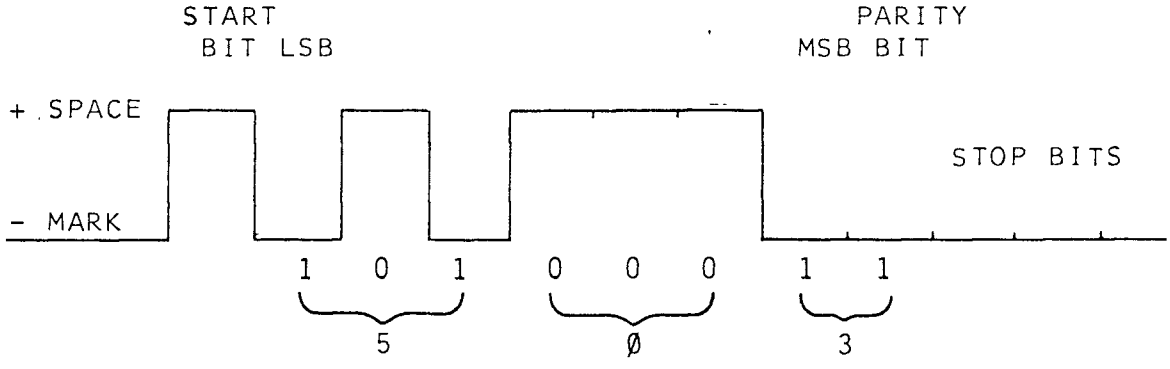



FIG. 2-2 THE TERMINAL IMP




Compatible ASCII Capital E

The number of data bits may be from 5 to 8 as determined by the parameter SIZE:

| SIZE | NUMBER OF DATA BITS |
|---|---|
| 0 | 5 |
| 1 | 6 |
| 2 | 7 |
| 3 | 8 |

*Signal Levels* - All the signals at the EIA connector of an LIU are EIA compatible, and interpreted in this way:

Data Signals

-25<Vd<-3v. is marking or logical one
+3<Vd<+25v. is spacing or logical zero

Control & Timing Signals

-25<Vc<-3v. is considered OFF
+3<Vc<+25v. is considered ON

The input and output rates which can be used are:

| Code | Rate (baud) |
|---|---|
| 0 | illegal |
| 1 | 75 |
| 2 | 110 |
| 3 | 134.5 |
| 4 | 150 |
| 5 | 300 |
| 6 | 600 |
| 7 | 1200 |
| 10 | 1800 |
| 11 | 2400 |
| 12 | 4800 (output only) |
| 13 | 9600 (output only) |
| 14 | 19200 (output only) |
| 15 | illegal |
| 16 | illegal |
| 17 | external clock |

## 2.2 Data Flow in the MLC

Block diagrams of the Input and Output data paths are shown in Figures 2.2-3 and 2.2-4. Except for the common logic and H316 Mainframe, the Input and Output circuitry are independent. The LIU pads referred to in these figures are shown in Appendix A.

The fields marked by asterisks are shown on the MLC console. For example, the MSTAT bits are labeled in this manner:

MSTAT (light on indicates 1)

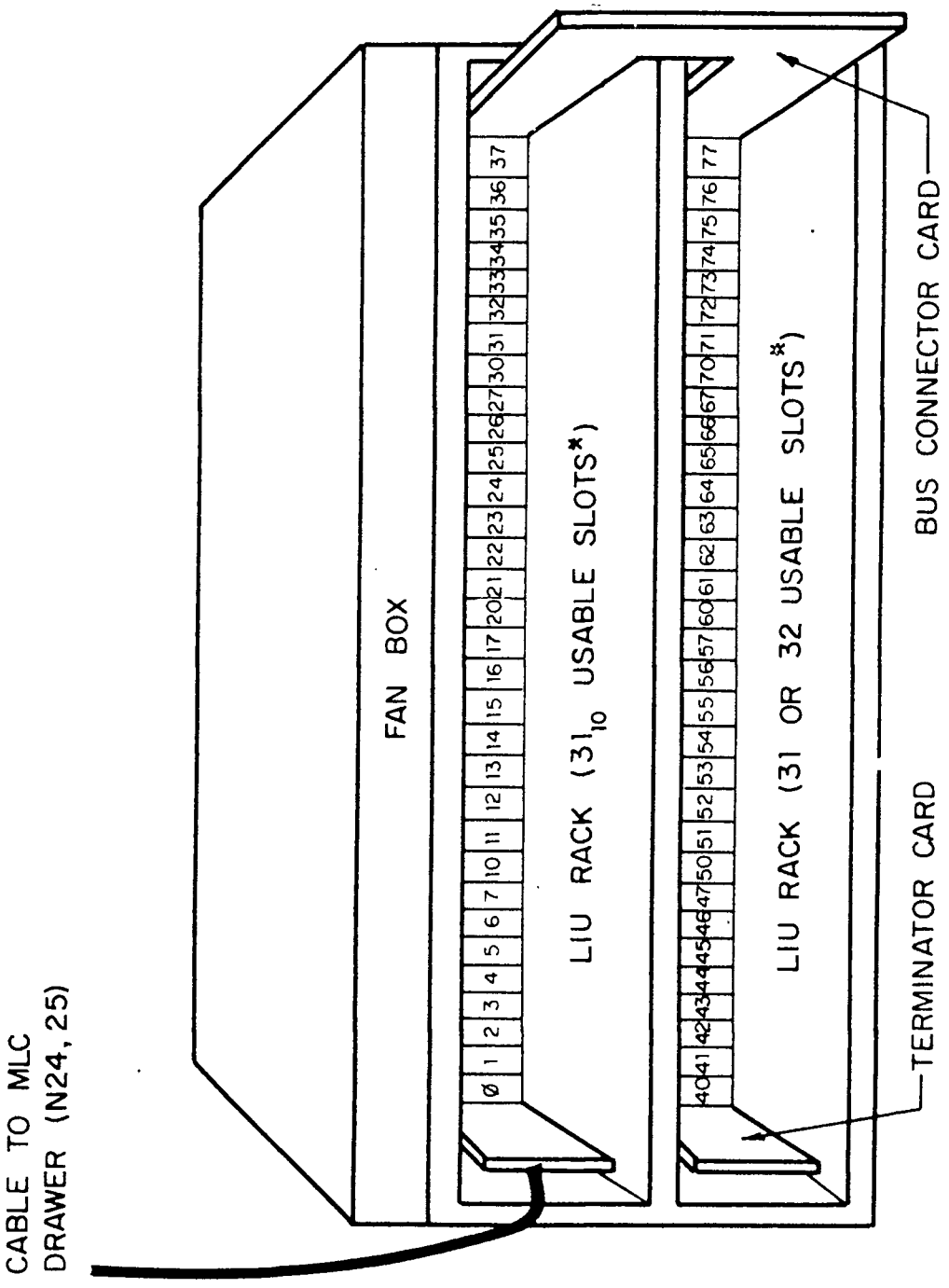
| 0 | 0 | 0 | 0 | 0 | 0 |
|---|---|---|---|---|---|
| Ø | 1 | 2 | 3 | 4 | 5 |

The fields BOUTDAT, BINDAT, SIZE, INRATE and OUTRATE have the least significant bit on the right.

The upper half of the MLC console is associated with the central logic which is common to all lines. The lower half displays the status of an individual line. The line to be displayed is selected by entering the line number into the LINE SELECT switches. The setting of these switches concerns only the display and in no way affects the internal functioning of the MLC. The line number (octal) is determined by the slot in the LIU rack into which the desired LIU is plugged. (Slot 0 is empty.) See Figure 2.2-1.

Most of the user commands in the TIP User's Guide refer to the decimal equivalent of this line number. Don't get confused.

A diagram of the MLC console is shown in Figure 2.2-2, and the fields are summarized in Table 2.2-1. Throughout the following discussion, inversions of the signals are not indicated.




*LIU SLOTS NUMBERED IN OCTAL Ø-77. SLOT Ø IS NEVER USED, SLOT 77 IS UNUSED IN SYSTEMS WITH MAG TAPE OPTION.

FIG. 2.2-1 MLC LINE INTERFACE UNITS RACK

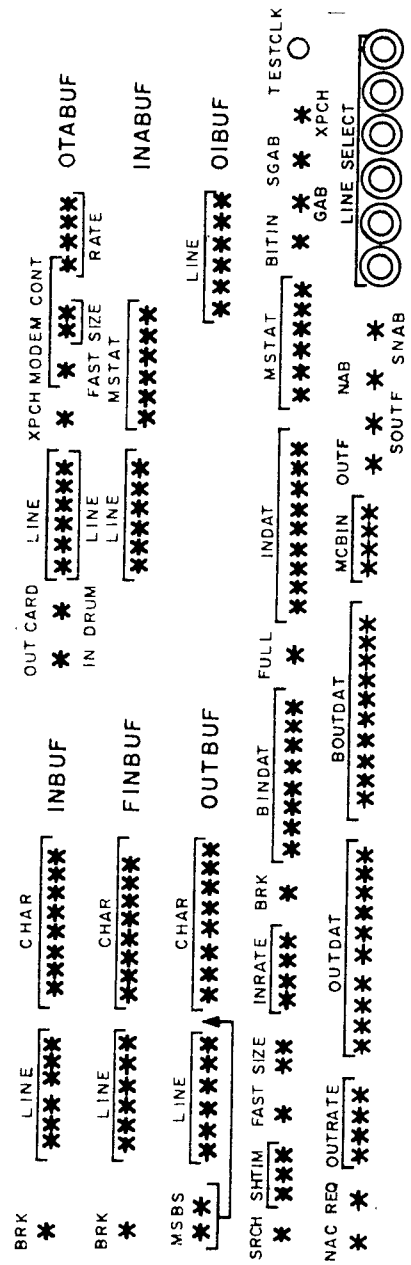



FIG. 2.2-2 MLC CONSOLE

| Field Name | Bits | Function |
|---|---|---|
| *FAST | 1 | Input to be routed through fast channel |
| *SIZE | 2 | Character size |
| *INRATE | 4 | Baud rate for input to MLC |
| *BRK | 1 | Input line is breaking |
| *BINDAT | 8 | Buffered input data (holds the last character inputted) |
| *INDAT | 8 | Input data shift register |
| *MSTAT | 6 | Status from data set on LIU card |
| *XPCH | 1 | Crosspatch test enabled on LIU card |
| *TESTCLK | switch | Serves as synchronous clock when LIU is crosspatched |
| *OUTRATE | 4 | Baud rate for output from MLC |
| *OUTDAT | 1Ø | Output data shift register |
| *BOUTDAT | 1Ø | Buffered output data (holds the last character sent to the port from the TIP) |
| *MCBIN | 4 | Control information to data set on LIU card |

Note: Those fields not listed above are for maintenance purposes only.

For further details consult TIP Hardware Manual, BBN Report No. 2184.

TABLE 2.2-1 MLC CONSOLE FIELD DESCRIPTIONS

### 2.2.1 Input

The input block diagram is shown in Figure 2.2-3. The input section provides these functions:

- 6 status inputs
- Input data path
- Variable input rates
- External clock

The status inputs (MSTATØ through MSTAT5) are direct input paths which may be read at any time by the processor. Their use will be described in the subsection on software (2.3).

The input character is assembled in the Input Data Shift Register. When complete, it is transferred into the Buffered Input Data Register, from which it is transferred to the mainframe memory. The character length is determined by SIZE, and the rate by INRATE. If the rate is specified as octal 17, the clock for the Input Data Shift Register is taken externally on the path External Input Clock. The Input Data is captured on the negative edge of the signal on LIU pin E17 or E25. If the Input Data line is held spacing during the first stop bit of a character, the line is determined to be breaking, and BRK is set.

The last character received is held in BINDAT.

### 2.2.2 Output

The output block diagram is shown in Figure 2.2-2. The output section provides these functions:

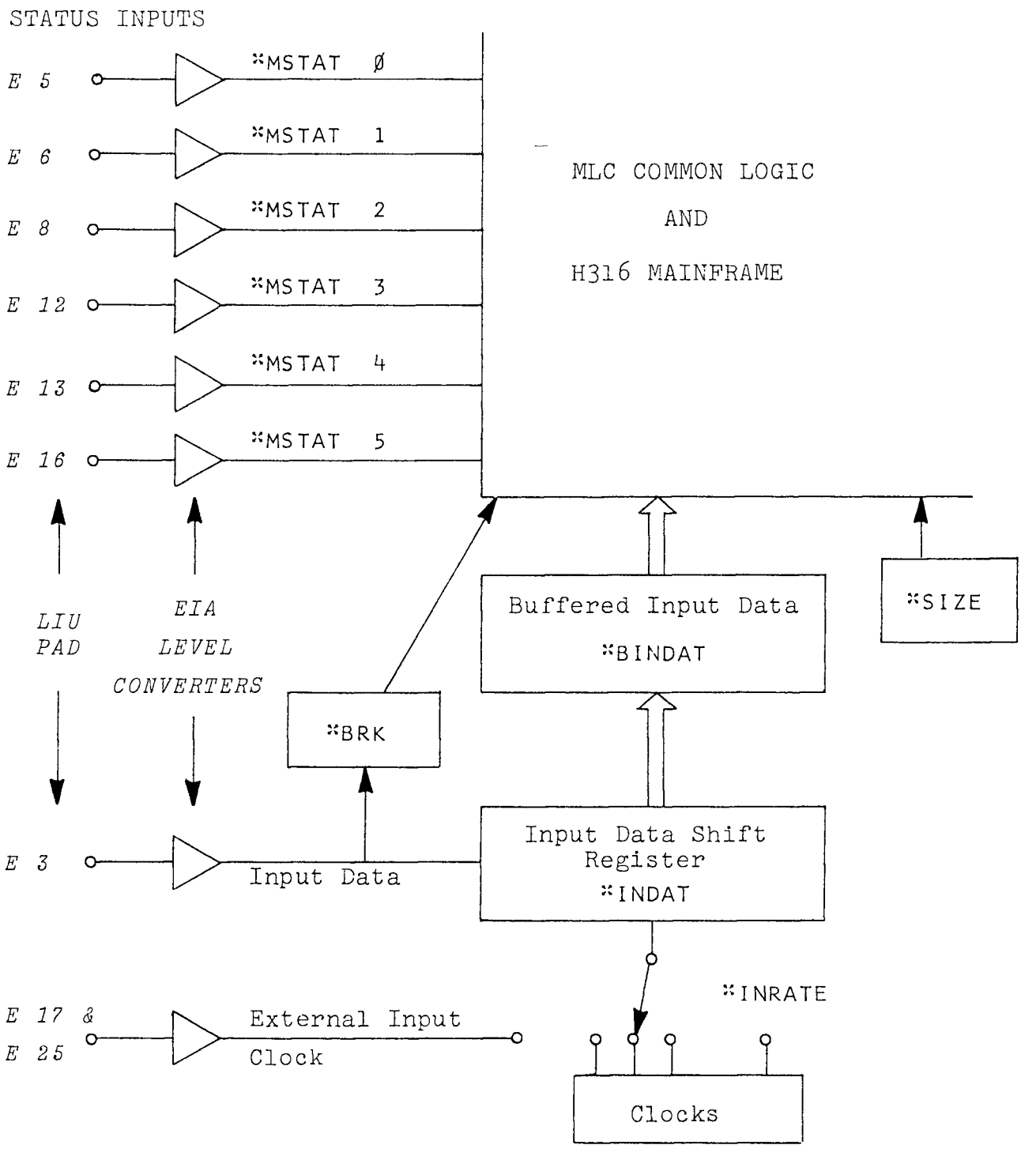
- 4 control outputs
- Output data path

- Variable output rate
- External clock

The control outputs (MCBIN Ø through MCBIN 3) are direct output paths which are controlled by the software. Their use will be described in the subsection on software (2.3).

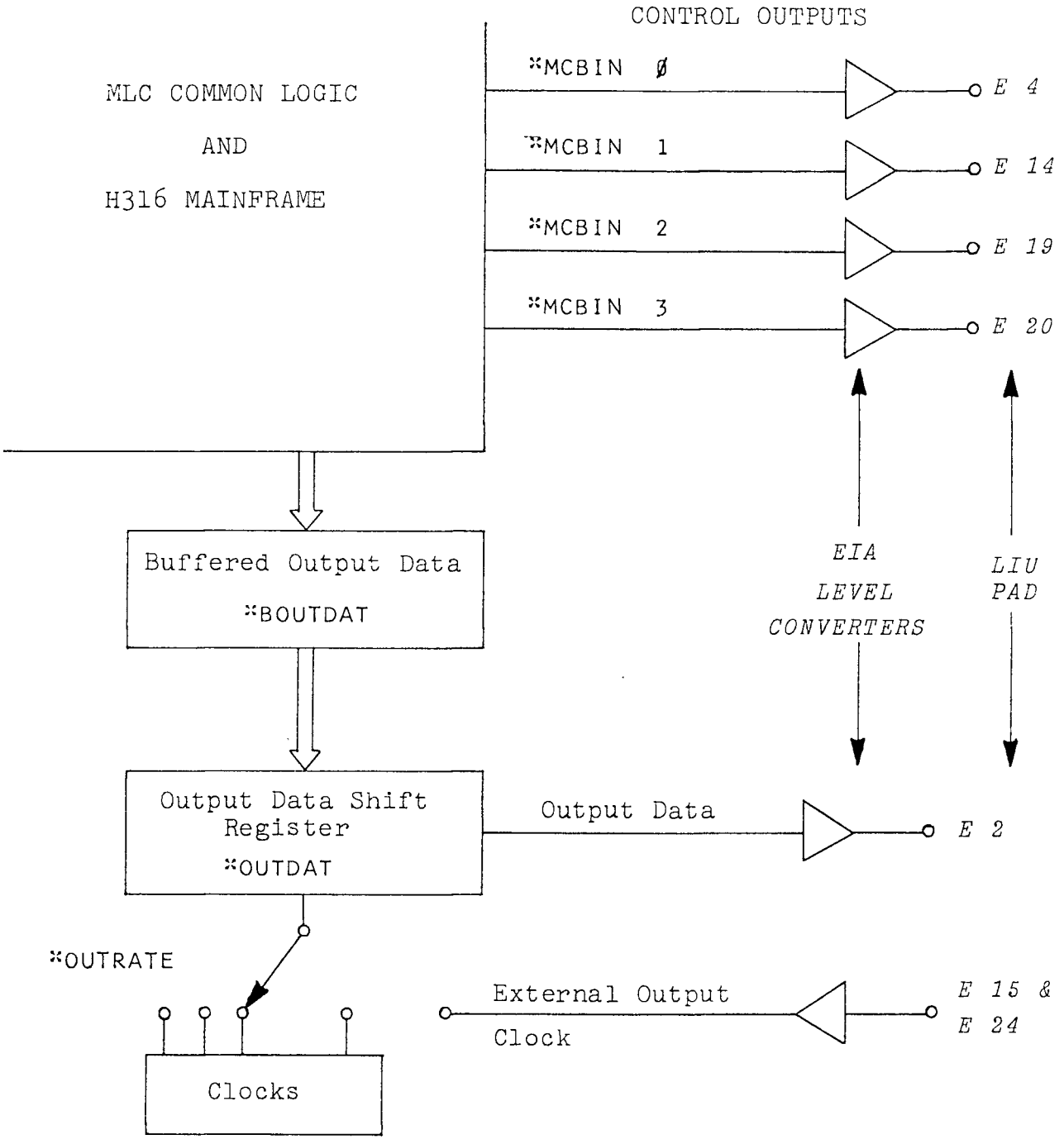
The output character is delivered to the Buffered Output Data Register from the mainframe memory. When the last character has left the Output Data Shift Register, the next character is transferred into it from the Buffered Output Data Register; then the character is shifted out with start and stop bits added. The rate is determined by OUTRATE. If rate 17 (octal) is specified, the clock for the Output Data Shift Register is taken externally from the path External Output Clock. The output data changes on the positive going edge of the signal on LIU pads E15 and E24.

The last character sent out is held in BOUTDAT.




*MANIFOLD TYPE - Indicates fields which have corresponding light-emitting diodes on the MLC console.

FIG. 2.2-3 MLC DATA PATH BLOCK DIAGRAM - INPUTS




*MANIFOLD TYPE - Indicates fields which have corresponding light-emitting diodes on the MLC console.

FIG. 2.2-4 MLC DATA PATH BLOCK DIAGRAM - OUTPUTS

## 2.3 Software Description

The TIP software is currently undergoing changes to expand its capabilities; this subsection describes the way the software uses the MLC now. The TIP User's Guide should be read for information concerning software facilities available to the user.

At this time, the software handles the control and status bits in this way:

- MSTAT Ø,1,3,4,5, are ignored by the software.
- MCBIN Ø,1,2 are held ON by the software.
- MCBIN 3 is held ON, except for a short (approximately 1/2 sec.) period following an ON to OFF transition of MSTAT 2, during which it goes OFF.
- MSTAT 2 is used by the TIP software to determine that the terminal is connected to the TIP, and able to transfer data. If "hunt" mode is enabled for this device, an ON to OFF transition of this signal initiates "hunt" mode.

Also, at this time, the software is not capable of keeping output lines full at speeds greater than about 3000 baud.

# 3. TERMINAL/TIP INTERFACE SPECIFICATION

This section specifies the interface between a terminal and the TIP. See Section 4 for connections involving modems. It is hoped that by examining this section, an engineer will be able to determine whether he has met the conditions necessary for proper operation of a terminal connected to the TIP.

To a large extent, the TIP follows EIA Standard RS-232C. Familiarity with that document is recommended. The pin allocations specified by that standard are given inside the front cover.

In order to connect a terminal to the TIP without modems, each must look like a modem to the other. Input and output connections are therefore cross-connected at the LIU pads, as shown in Table 3-1.

Expansions to this specification are planned in the near future (particularly as this relates to control signals). It is therefore very important that this section be kept up-to-date as revisions are provided.

*Connector* - The connector from the terminal should be equivalent to a Cinch DB-25P. It is recommended that extension cords for terminals provide for all 25 pins in order to allow for future changes.

*Signal Levels* - All signals are represented by bipolar low voltage levels. All signals are measured with respect to signal ground. The source of a signal shall deliver a voltage of magnitude between 5 and 25 volts into a load of not less than 3000 ohms. The reactive component of the load shall not be inductive, and the capacitance shall not exceed 2500 pfd. measured at the interface connector. The signals shall be interpreted in this way:

Data Signals

$-25<Vd<-3$ is marking or logical one

$+3<Vd<+25$ is spacing or logical zero

## Control & Timing Signals

-25<Vc<-3 is considered OFF
+3<Vc<+25 is considered ON

*Signal Use* - The TIP software handles the signals as shown in Table 3-1.

*Data Format* - The terminal data format must be serial, with characters framed by start and stop bits as in Figure 3-1. The number of data bits per character is from 5 to 8 inclusive. This is determined by the two-bit character SIZE:

| SIZE | NUMBER OF DATA BITS |
|---|---|
| 0 | 5 |
| 1 | 6 |
| 2 | 7 |
| 3 | 8 |

*Device Rates* -

| Code | Rate (baud) |
|---|---|
| 0 | illegal |
| 1 | 75 |
| 2 | 110 |
| 3 | 134.5 |
| 4 | 150 |
| 5 | 300 |
| 6 | 600 |
| 7 | 1200 |
| 10 | 1800 |
| 11 | 2400 |
| 12 | 4800 (output only) |
| 13 | 9600 (output only) |
| 14 | 19200 (output only) |
| 15 | illegal |
| 16 | illegal |
| 17 | external clock |

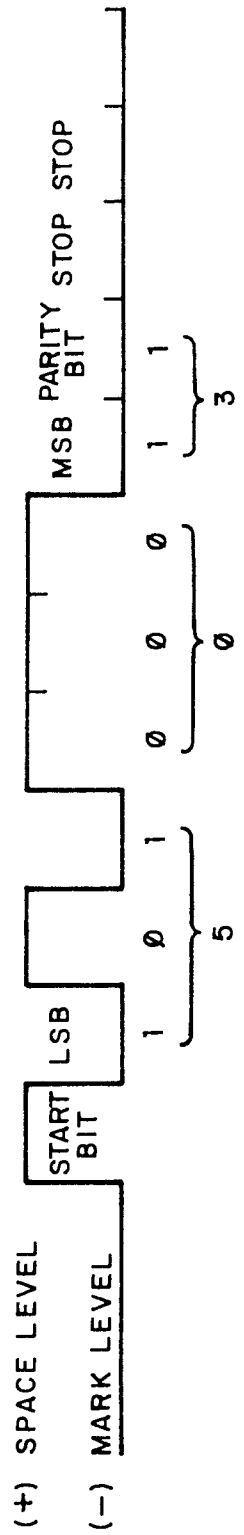



FIG. 3-1 COMPATIBLE "E" (ASCII 305)

*Character Code* - The TIP software accepts ASCII 8-bit code. Parity is ignored on input, and undefined on output. IBM 2741 and 2741-like devices are handled specially. See Appendix C.

*Carriage Return Speed* - Carriage return speed is known to be reasonably compensated for Teletypes 33, 35, and 37; and, separately, for Execuport-like devices. A line printer (ODEC) with a small (256-character) buffer is also reasonably compensated. This compensation is set by the TIP program.

*Half-Full Duplex* - The TIP can handle both half and full duplex terminals, provided that the half-duplex connection accepts control signals which are used as indicated in Table 3-1.

*Terminals Which Provide Their Own Clock* - Terminals which provide their own clocks for transferring data can be connected to the TIP provided they meet the previous specifications. The clocks should be routed to LIU pads E15 and E17. The data lines should change on the positive edges of the clocks, and should be sampled on the negative edges.

TABLE 3-1 TIP SIGNAL ALLOCATION FOR TERMINALS*

| EIA PIN | LIU PAD | DESIGNATION (FROM THE POINT OF VIEW OF THE TERMINAL) |
|---|---|---|
| 1 | E1 | PROTECTIVE GROUND (AA) - Used. |
| 2 | E3 | TRANSMITTED DATA (BA) - Used for data going from the terminal to the TIP. |
| 3 | E2 | RECEIVED DATA (BB) - Used for data going from the TIP to the terminal. |
| 7 | E7 | SIGNAL GROUND (AB) - Used. |
| 8 | E20 | RECEIVED LINE SIGNAL DETECTOR (CF) - Modem control bit 3. Held ON by the TIP, except for a short (approximately 1/2 sec.) period following an ON to OFF transition of DATA TERMINAL READY, during which it goes off. |
| 20 | E8 | DATA TERMINAL READY (CD) - Modem status bit 2. THIS SIGNAL IS USED BY THE TIP to determine that the terminal is connected to the TIP. If "hunt" mode is enabled for this device, an ON to OFF transition of this signal initiates "hunt" mode. |
| | | The following control signals are held on by the TIP software: |
| 5 | E4 | CLEAR TO SEND (CB) - Modem control bit Ø. Held ON by the TIP. |
| 6 | E19 | DATA SET READY (CC) - Modem control bit 2. Held ON by the TIP. |
| 16 | E14 | SECONDARY RECEIVED DATA (SBB) - Modem control bit 1. Held ON by the TIP. |
| | | The following status signals are ignored by the TIP software: |
| 4 | E5 | REQUEST TO SEND (CA) - Modem status bit Ø. Ignored by the TIP. |
| 12 | E12 | SECONDARY RECEIVED LINE SIGNAL DETECTOR (SCF) - Modem status bit 3. Ignored by the TIP. |
| 13 | E13 | SECONDARY CLEAR TO SEND (SCB) - Modem status bit 4. Ignored by the TIP. |
| 14 | E16 | SECONDARY TRANSMITTED DATA (SBA) - Modem status bit 5. Ignored by the TIP. |
| 19 | E6 | SECONDARY REQUEST TO SEND (SCA) - Modem status bit 1. Ignored by the TIP. |

*This configuration makes the LIU look approximately like a 103 modem to the terminal.

# 4. MODEMS

It is desired that the TIP be able to operate with terminals over private or leased lines, or over the switched telephone network. This requires the use of a pair of modems between the terminal and the TIP. At the present time, only one such modem (Bell 103, or equivalent) is supported by the TIP software. We expect to be able to support 202-equivalent modems (with reverse channel) in the future.

If may be that a group desiring to use another type of modem could coax that modem to work within the available software and hardware structure. For that purpose, this section will try to describe the difficulties in using half-duplex modems, the use of synchronous modems, and the manner in which the 103 modem is supported.

## 4.1 Half-Duplex Modems

Half-duplex modems are modems in which data on the primary data channel can flow in only one direction at a time. Data cannot flow both ways at the same time. There may or may not be a "secondary" or "supervisory" channel which points in the direction opposite the primary channel. The essential problem involved in half-duplex operation is control of the direction of data flow on the primary channel. Significant questions are:

- What protocol should be adopted for turning the line around—special control characters, or use of a secondary channel?
- Which end (if either) is in control of the channel?

- If the terminal is receiving a large listing, how can the user terminate the output when the channel is pointing the wrong way?

- Who should do the echoing and when?

These problems are clearly a matter of convention. Unfortunately, EIA Standard RS-232, which many modems follow, does not define a convention which would answer these questions. It is very helpful if a request to BBN for a modem on the TIP includes a statement of what terminals are to be connected to the other end, and what convention they follow.

## 4.2 Synchronous Modems

Synchronous modems normally do not use the character format shown in Figure 3-1. Such a connection to the TIP does not work. However, the TIP should be able to use synchronous modems provided that the characters are framed by start and stop bits, and that the synchronous modem is similar enough to a modem which is supported by the software. The device rate must be set to 17 octal through the use of @ DEVICE RATE 1Ø23. This disables Hunt mode, therefore when this modem is disconnected from the LIU, remember to re-enable "hunt" mode with @ DEVICE RATE 4534 (for example). See TIP User's Guide.

## 4.3 103 Modems

Description:

The Bell Telephone 103 modem is a low-speed (up to 300 baud), asynchronous, full-duplex modem for use on private leased lines or the switched telephone network.

Connection:

See Table 4.3-1 for the pin connection on the LIU card, and for a description of the TIP's use of the signals.

Operation:

In use, the modem at the TIP end is usually left in the AUTO mode. When a user wishes to connect his terminal, he dials the number of the modem at the TIP. After the ring is answered and a data carrier is heard, the user depresses the DATA button. The user is then connected as if his terminal were connected directly to the TIP. He types the characteristic character for his terminal, receives HELLO, and proceeds to use the network as desired.

TABLE 4.3-1

TIP SIGNAL ALLOCATION FOR 103 MODEM

| EIA PIN | LIU PAD | |
|---|---|---|
| 1 | E1 | PROTECTIVE GROUND (AA) - Used. |
| 2 | E2 | TRANSMITTED DATA (BA) - Used for data going from the TIP to the MODEM. |
| 3 | E3 | RECEIVED DATA (BB) - Used for data going from the MODEM to the TIP. |
| 5 | E5 | CLEAR TO SEND (CB) - Modem status bit Ø. Ignored by the TIP. |
| 6 | E6 | DATA SET READY (CC) - Modem status bit 1. Ignored by the TIP. |
| 7 | E7 | SIGNAL GROUND (AB) - Used. |
| 8 | E8 | RECEIVED LINE SIGNAL DETECTOR (CF) - Modem status bit 2. This signal is used by the TIP to determine that a connection has been made. If "hunt" mode is enabled for this device, an ON to OFF transition initiates "hunt" mode. |
| 20 | E20 | DATA TERMINAL READY (CD) - Modem control bit 3. Held ON by the TIP, except for a short (approximately 1/2 sec.) period following an ON to OFF transition of RECEIVED LINE SIGNAL DETECTOR. This disconnects the telephone line in preparation for the next call.* |

All other signals are connected as shown in Appendix A but are not used by the 103 modem.

*It should be noted that if the carrier is lost for a short time, a disconnect is initiated. Also, if the carrier is not detected (for example, by a voice call) no disconnect will occur.

# APPENDIX A

## STANDARD LIU CARD CONFIGURATIONS FOR TERMINALS AND MODEMS

## STANDARD LIU CARD CONFIGURATIONS FOR TERMINALS AND MODEMS

In order to provide the necessary flexibility in assigning the pins on the EIA (DB-25P) connector to the various inputs and outputs of the LIU, a patch panel is provided on the LIU card. The pin assignment is shown in Figure A-1.

Table A-1 shows the interconnection necessary to configure the LIU to drive terminals or modems.